

SUMMARY OF RESPONSE TO DETAILED ACTION

August 27, 2002

Assistant Commissioner for Patents

Washington D.C. 20231

Petition to examiner Ruth A. Davis

Referring to Detailed Action date mailed 08/ 12/ 2002, regarding patent application serial number 09/ 734,466⁸⁸, filed by Gene E. Lightner 12/11/2000, Summary Of Response To Detailed Action is enclosed within.

The claims and specification page 4 and page 6 have been amended to achieve requested allowance.

- DO NOT ENTER
RAD
9/16/02
- The word "gasohol" is the word recognized and used by those of understanding to describe gasoline containing alcohol (ethanol). The term, "gasohol containing water," is found within amended specification page 4. Thus an antecedent basis for the term "gasohol containing water" is provided.
 - The term "providing controlled flow rate of gaseous carbon dioxide" is within amended claim 1. This term is a positive statement and expected to be allowed.

The prior art was considered unrelated to the present invention, as a method to provide a controlled flow rate of gaseous carbon dioxide to humidify ethanol was lacking. The essence of the present invention is providing a controlled flow rate of gaseous carbon dioxide with the purpose to humidify ethanol.

After reviewing the prior art, applicable methods to the present invention were devoid. It is expected that, upon examination of these findings, the amended claims and specification will be allowed by the examiner, as requested.

Clean copies, without page numbers, of the claims and amended specification page 4 and page 6 are enclosed.

Very respectfully,

Gene Lightner

Gene E. Lightner

RESPONSE TO DETAILED ACTION

Examiner Ruth A. Davis.

Pertaining to attached Office communication concerning this application date mailed: 08/12/2002, regarding proceeding of patent application serial number 09/ 734,488, filed by Gene E. Lightner 12/11/2000, response to Office Action is enclosed within, and is referred to by numbers within the DETAILED ACTION.

1. Regarding claim 13, this claim is amended to replace "extactate" by extractate.

13. (amended), The method of claim 12 wherein the solution containing ethanol is extracted by gasoline to produce an [extactate] extractate of gasoline within dissolved ethanol and a solution substantially free of ethanol. Thereupon appropriate correction action as required is provided.

2. The quotation of the second paragraph of 35 U.C.S. 112 is resolved within numbered section 3.

3. Regarding claims 1 -20, the amended statement within the specification page 6, lines 19-21. In the preferred embodiment of the present invention, a fermented broth is co-mingled with provided controlled flow rate of gaseous carbon dioxide, forming two phases for humidifying the carbon dioxide with ethanol from the fermented broth." This statement is definite and found within the specification page 6, lines 19-21. To additionally define provided carbon dioxide within the amended specification page 6, lines 27-28, "Upon fermentation, the broth forms ethanol and carbon dioxide which [is] are transmitted to provided carbon dioxide." Also the statement, contained within the specification page 6, line 6, "FIG. 1 is a flow sheet denoting the invention as set forth in the appended claims." Second paragraph, presented within 35 U.C.S. 112, "The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. Thus conditions of 35 U.C.S. 112, second paragraph have been fulfilled.

Introductory statement of Claim 1, "What is claimed is:" particularly points out and distinctly claims the subject matter regarded as the invention. Furthermore, "1. A method to separate ethanol from a fermentation broth," states the objective of the current invention, followed by "which comprises:" Steps within claim I are each accomplished by ", and" to delineate the steps of the current invention. Dependent claims or preceding dependent claims, are ultimately dependent on claim I. Descriptions within dependent claims will distinguish between

functional/operational functions and are provided for explanation and unintended to be principally descriptive in nature.

Regarding claim 10, the elucidation, "for forming enzymes required for fermentation" could be deleted from the claim to accordingly avoid an explanation of the intended use of the microorganisms.

Microorganisms for fermentation frequently include yeasts to form enzymes required for fermentation of glucose as well as five carbon sugars. Hence claim 10, remains unchanged.

Regarding amended claim 13, the fact that the extractate containing gasoline and ethanol is gasohol, is apparent from one skilled in the art. Therefore, introduction of the term "gasohol" within amended claim 13 is needless, and is submitted in the amended specification page 4, lines 25-27.

Regarding claim 16, the claim is amended for clarification of the intent without changing scope.

16. (amended), The method of claim 1 wherein [the] said controlled flow rate of gaseous carbon dioxide, combined with carbon dioxide produced by fermentation, is humidified and saturated by water so that further humidification by the carbon dioxide will produce humidified ethanol from the fermentation broth without substantially producing additional humidified water from the fermentation broth. Any volatile compound, including water, within the broth is subject to being humidified by carbon dioxide. Establishing saturation of humidified water within said controlled flow rate of gaseous carbon dioxide, prevents subsequent humidification of water. Saturation of humidified water within the gaseous carbon dioxide is apparent and intends to convey this condition.

Regarding claim 18 (amended) and claim 19. 18. (amended) The method of claim 17 wherein the gasohol containing water is dehydrated [by forming] to form [a hydrate and] dehydrated gasohol.

Claim 19 remains without amendment. Contained within the amended specification page 4, lines 25-27, "Accordingly gasoline containing ethanol and water can be employed to produce anhydrous [gasoline] gasohol by forming a hydrate within the [gasoline] gasohol containing water followed by separation of the hydrate to yield anhydrous gasohol." Hence a significant antecedent basis for the term "gasohol containing water" is provided without changing scope.

4. Referring to the quotation of 35 U.S.A. 103(a). The principle of humidifying ethanol contained within a fermentation broth with provided carbon dioxide is a practice lacking within the prior art and is hence inapplicable within the prior art. A search of the prior art, discovered that the prior art was devoid of employing gaseous carbon dioxide for humidifying ethanol, which is the fundamental principle employed herein. Accordingly the subject matter to be patented is both novel and unobvious.

5. With regards to 35 U.S.A. 103(a) and claims 1-4 and 6-10. Claim 1 has been primarily amended for clarification. Dependent claims 2-20, or preceding dependent claims, are ultimately dependent on claim 1. Accordingly claims 1-4 and 6-10, as amended, are dependent on claim 1, as amended. Consequently references to Hallberg in view of Tedder are unrelated to the heretofore cited claims.

Applicant correctly argues that references are lacking within teachings of providing a controlled flow rate of gaseous carbon dioxide for humidification of ethanol within fermentation broth. The intention of a controlled flow rate of gaseous carbon dioxide for humidification of ethanol within fermentation broth results in moderate ethanol concentration within the fermentation broth as anticipated. Therefore provision of a controlled flow rate of gaseous carbon dioxide for humidification is a structural difference between the claimed invention and the prior art. Bringing about humidification of ethanol by gaseous carbon dioxide is devoid within prior art and will contribute order so as to patently distinguish manipulative difference as compared to the prior art. These arguments are intended to persuade because the references are lacking provision of a controlled flow rate of gaseous carbon dioxide to provide humidification of ethanol. Provision for controlled flow rate of gaseous carbon dioxide, combined with carbon dioxide produced by fermentation, followed by humidification of ethanol within fermentation broth, provides a structure lacking within the prior art, to distinguish manipulative difference as compared to the prior art.

Declared within the previously submitted amended claim 1, page 11, lines 10-11 "providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and" clearly states a structure to humidify ethanol. Thus the intended use of a controlled flow rate of gaseous carbon dioxide is to humidify ethanol. The prior art is lacking of *in situ* vaporization of ethanol to form humidified carbon dioxide. Regulated concentration of ethanol within the fermentation broth is desired to prevent concentration of ethanol buildup, which if unregulated, would be lethal to microbes within the fermentation broth and accordingly prevent further fermentation. Mention of the verb, to humidify in any form, is devoid within each teaching, hence these teachings are irrelevant to the present invention.

Regarding Casey and Otto, the court held that the intended use of hair curling was of no significance to the structure and process of making. The structure, providing gaseous carbon dioxide to humidify ethanol, within claim 1, is applied within the present invention.

Although Tedder teaches use of an organic solvent, the removal of sludge and addition of microbes, nutrients and sugars, are features notably common in the art. Removal of sludge will prevent buildup of decreased activity of aged microbes.

Regarding amended claim 1, the resulting humidification of ethanol specifically puts limitation on concentration of fermentation broth, from which the ethanol was obtained. To one skilled in the art, it is evident that ethanol must be vaporized to give rise to humidification of ethanol. The references and claims within art cited, evidently are devoid of *methods* that *may* regulate ethanol concentration by humidified carbon dioxide, thus the art cited is properly inapplicable. For the reasons above and those made previously of record, the claims are rendered novel and unobvious (by) of the cited references.

6. Regarding claims 1-11 and 17 and referring to 35 U.S.A. 103(a), as being unpatentable over Hallberg in view of Tedder and further in view of Terpin. References to applying gaseous carbon dioxide for humidifying ethanol are lacking from the teachings of Hallberg in view of Tedder and further in view of Terpin, for employing gaseous carbon dioxide to humidify ethanol.

Applicant correctly argues that references are lacking within these teachings. Provision for providing a controlled flow rate of gaseous carbon dioxide, combined with carbon dioxide produced by fermentation, followed by humidification of ethanol, provides a structural difference between the prior art. A structural difference is accordingly provided and claimed within amended claim 1., declaring "providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and" clearly states a structure to humidify ethanol. Therefore the intended use of a controlled flow rate of gaseous carbon dioxide is to humidify ethanol is a structural difference and renders prior art inapplicable to the present invention. The prior art structure is absent of "providing a controlled flow rate of gaseous carbon dioxide." It has been determined that patentably and features that distinguish providing a controlled flow rate of gaseous carbon dioxide are lacking within prior art. Hence it is concluded that prior art structure and manipulative difference exclude accomplishing humidification by a controlled flow rate of gaseous carbon dioxide. These arguments are intended to persuade because the reference within prior art structure is lacking provision of a controlled flow rate of gaseous carbon dioxide to provide humidification of ethanol. Therefore provision of this structure is lacking and incapable of performing the intended use.

Pertaining to Casey and Otto, the conclusions previously stated within page 3 of this Office Action remains unchanged.

Concerning claim 1, specifically includes a limitation drawn to the moderation of ethanol and by providing a controlled flow rate of gaseous carbon dioxide, so the art is properly inapplicable. Moreover, for the reasons stated above, disregarding the previous reasoning, the fact that, to this date, the prior art is lacking provision of providing carbon dioxide to a fermentation broth, with the intention to humidify ethanol within the broth, accordingly the invention application is both novel and unobvious.

7. Regarding claims 1-11 and 17-20 and referring to 35 U.S.A. 103(a), as being unpatentable over Hallberg in view of Tedder and further in view of Chambers.

References to applying gaseous carbon dioxide for humidifying ethanol are lacking from the teachings of Hallberg in view of Tedder and further in view of Chambers, for employing gaseous carbon dioxide to humidify ethanol.

Applicant correctly argues that references are lacking within these teachings. Provision for providing a controlled flow rate of gaseous carbon dioxide, combined with carbon dioxide produced by fermentation, followed by humidification of ethanol, provides a structural difference between the prior art. A structural difference is accordingly provided and claimed within amended claim 1., declaring "providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and" clearly states a structure to humidify ethanol. Therefore the intended use of a controlled flow rate of gaseous carbon dioxide is to humidify ethanol is a structural difference and renders prior art inapplicable to the present invention. The prior art structure is absent of "providing a controlled flow rate of gaseous carbon dioxide." It has been determined that patentably and features that distinguish providing a controlled flow rate of gaseous carbon dioxide are lacking within prior art. A manipulative difference is without application within the prior art as compared to the prior art. Hence it is concluded that prior art structure and manipulative difference exclude accomplishing humidification by a controlled flow rate of gaseous carbon dioxide. These arguments are intended to persuade because the reference within prior art structure is lacking provision of a controlled flow rate of gaseous carbon dioxide to provide humidification of ethanol. Therefore provision of this structure is lacking and incapable of performing the intended use.

Pertaining to Casey and Otto, the observations and conclusions previously stated within page 3 of this Office Action remains without change.

Regarding claim 1, which specifically includes a limitation drawn to the moderation of ethanol and by providing a controlled flow rate of gaseous carbon dioxide, so the art is properly inapplicable. Moreover, for the reasons stated above, disregarding the previous reasoning, the fact that, to this date, the prior art is lacking provision of providing carbon dioxide to a fermentation broth, with the intention to humidify ethanol within the broth, accordingly the invention application is both novel and unobvious.

Furthermore, although Tedder teaches use of an organic solvent, the removal of sludge and addition of microbes, nutrients and sugars, were common practices in the art at the time the claimed invention was made. This reference is used to demonstrate continuous fermentation, and consequently unrelated to humidified ethanol within carbon dioxide.

Chambers demonstrates methods for providing gasohol wherein alcohol and gasoline are combined, dehydrated and condensed, thereby demonstrating such methods as claimed were well known at the time of the claimed invention. This practice is a limitation within the present amended claim 1. Furthermore the necessary fact that humidified ethanol within carbon dioxide is employed to bring about gasohol is absent within the prior art. The teachings of Chambers are hence inapplicable within the present patent application.

A search of patents, discovered that the prior art is devoid of employing gaseous carbon dioxide for humidifying ethanol, which is the fundamental principle employed herein.

Accordingly, it was concluded that the subject matter to be patented is both novel and unobvious.

The fact that, to this date, purposely providing carbon dioxide to a fermentation broth, with the intention to humidify ethanol within the broth, thus the invention is both novel and unobvious.

The prior art accordingly presents options immaterial to the present invention. The examiner has failed to submit *prima facie* evidence or convincing reasoning that humidification of ethanol by gaseous carbon dioxide was considered within prior art.

In conclusion, the essence of the present invention is providing gaseous carbon dioxide with the deliberate intention of humidifying ethanol produced by fermentation.

8. In respect to the three month statutory period, a reply to this final action will be submitted well before the three month statutory period

Concerning this communication from the examiner, an inquiry is unforeseen at this time.

What is claimed is:

1. A method to separate ethanol from a fermentation broth,
which comprises:

providing a fermentation vessel within which ethanol and carbon dioxide are produced, and
providing a mixture of microorganisms, nutrients and sugars to form a volume of broth contained
within said fermentation vessel, and

subjecting said broth within said fermentation vessel to fermentation to form ethanol and carbon
dioxide, and

providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify
ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and
separating the carbon dioxide, containing humidified ethanol and carbon dioxide produced by
fermentation, from the fermentation vessel, and

removing ethanol from the separated humidified carbon dioxide to substantially remove ethanol from
carbon dioxide to provide carbon dioxide to humidify ethanol, and

separating sludge and broth from said fermentation vessel, and

providing said mixture, to replace the volume of separated sludge and broth, to maintain substantially
constant volume of broth within the fermentation vessel thereby removing ethanol within broth, to
regulate concentration of ethanol, and removing carbon dioxide from the fermentation vessel.

2. The method of claim 1 wherein said fermentation broth contains nutrients employed for
fermentation substantially maintained to provide nutrients utilized within fermentation.

3. The method of claim 1 wherein said fermentation broth is established at a temperature and
maintained at substantially isothermal conditions.

4. The method of claim 1 wherein said sugars are selected from the group consisting of glucose and
xylose and mixtures thereof.

5. The method of claim 1 wherein said carbon dioxide, containing humidified ethanol and carbon
dioxide produced by fermentation, contains ethanol vapor produced from heat formed during
fermentation.

6. The method of claim 1 wherein the microorganisms are yeasts for forming enzymes required for
fermentation to form ethanol and carbon dioxide.

7. The method of claim 1 wherein said fermentation vessel is operated in a continuous manner.

8. The method of claim 1 wherein said sludge and broth removed from said fermentation vessel are
settled within a vessel to substantially separate broth from sludge.

9. The method of claim 8 wherein the broth separated from the sludge is combined with said mixture of microorganisms, nutrients and sugars to maintain volume of broth within said fermentation vessel.
10. The method of claim 1 wherein the microorganisms are employed for forming enzymes required for fermentation to form ethanol and carbon dioxide.
11. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by a solvent to provide a solution containing ethanol and to provide carbon dioxide.
12. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by water to provide a solution containing ethanol and to provide carbon dioxide humidified by water.
13. The method of claim 12 wherein the solution containing ethanol is extracted by gasoline to produce an extractate of gasoline within dissolved ethanol and a solution substantially free of ethanol.
14. The method of claim 13 wherein the extractate is substantially dehydrated.
15. The method of claim 13 wherein the solution substantially free of ethanol is distilled to produce vapor and a raffinate.
16. The method of claim 1 wherein said controlled flow rate of gaseous carbon dioxide, combined with carbon dioxide produced by fermentation is humidified and saturated by water so that further humidification by the carbon dioxide will produce humidified ethanol from the fermentation broth without substantially producing humidified water from the fermentation broth.
17. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by gasoline to provide gasohol containing ethanol and to provide carbon dioxide containing gasoline.
18. The method of claim 17 wherein the gasohol containing water is dehydrated to form dehydrated gasohol.
19. The method of claim 17 wherein the gasohol containing water is dehydrated by distillation forming an azeotrope and dehydrated gasohol.
20. The method of claim 17 wherein the carbon dioxide containing gasoline is subjected to adsorption to form carbon dioxide substantially free of gasoline and an absorbate containing gasoline.

BRIEF DESCRIPTION OF THE DRAWINGS

The features that are considered characteristic of this invention are set forth within the appended claims. This invention, however, both as to its origination and method of operations as well as additional advantages will best be understood from the following description when read in conjunction with the accompanying drawings in which:

FIG. 1 is a flow sheet denoting the invention as set forth in the appended claims.

FIG. 2 is a flow sheet denoting an alternate method for substantially separating ethanol from ethanol humidified carbon dioxide.

FIG. 3 is a flow sheet denoting a method to substantially separate sludge from broth contained within broth and sludge.

FIG. 4 is a flow sheet denoting a method to substantially absorb ethanol humidified carbon dioxide with gasoline to form gasohol.

FIG. 5 is a flow sheet denoting an alternate method to substantially absorb ethanol humidified carbon dioxide with gasoline to form gasohol.

FIG. 6 is a flow sheet denoting a method to substantially extract ethanol contained within water with gasoline to form gasohol.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the present invention, a fermented broth is co-mingled with provided controlled flow rate of gaseous carbon dioxide, forming two phases for humidifying the carbon dioxide with ethanol from the fermented broth. The operating temperature range for fermentation is about 30°C to about 35°C.

The flow diagram of **Fig. 1** illustrates the general preferred embodiment of the present invention. In the diagram, rectangles represent stages, operations or functions of the present invention and not necessarily separate components. Arrows indicate direction of flow of material in the method.

Referring to **Fig. 1**, a mixture of microorganisms, nutrients and sugars **10** is provided to a fermentation vessel **12**, to form a fermentation broth. Upon fermentation, the broth forms ethanol and carbon dioxide which are transmitted to provided carbon dioxide **16**, devoid of released carbon dioxide **16A**. Released carbon dioxide **16A** removes the quantity of carbon dioxide formed from fermentation. The humidification and removal of formed ethanol contained within humidified

The reverse of humidification is dehumidification. These procedures occur with simultaneous heat and mass transfer. Humidification of ethanol to provide a vapor within a gas requires heat of vaporization derived from heat formed during fermentation of sugars. Sugars, capable of fermentation within which ethanol and carbon dioxide are produced, are selected from the group consisting of glucose, xylose and mixtures thereof. Dehumidification of ethanol transfers ethanol vapors from a gas to a phase of a difference in ethanol partial pressure acquiring heat of vaporization of ethanol within the process to provide heat to the phase and consequently the sensible heat of the phase. Fermentation evolves heat as disclosed by R.N. Shreve, *op.cit.* pages 672-673. Ethanol vapor required to humidify ethanol is accordingly supplied by heat evolved during fermentation.

Microorganisms contained within broth will ultimately lose activity for fermentation and must be removed and replaced by active microorganisms. Enzymes produced from microorganisms are proteins that can be coagulated and precipitated by heat or chemical compounds as established by Hill and Kelley within Organic Chemistry, 1943, pages 442-443. Therefore broth containing diminish activity of microorganisms and enzymes can be heated to produce insoluble sludge within broth.

A ternary system created by benzene to form a low boiling point azeotrope with ethanol, water and benzene is employed within distillation columns to produce anhydrous ethanol as described by R.N. Shreve, *op.cit.*, page 679. Analogously gasoline, ethanol and water form a low boiling point azeotrope which is utilized within distillation columns to produce anhydrous gasoline containing ethanol. Hydrocarbon compounds often found within gasoline are heptane and hexane. Azeotropes of these hydrocarbons, ethanol and water are listed in Handbook of Chemistry and Physics, 56th Edition, page D-42.

Salts subjected to water to form hydrates include calcium sulfate and aluminum sulfate as disclosed by R.N. Shreve, *op.cit.* page, 218 and page 436. Accordingly gasohol, containing ethanol and water, can be employed to produce anhydrous gasohol by forming a hydrate within the gasohol containing water followed by separation of the hydrate to yield anhydrous gasohol. For additional information, review F. Daniels, Outlines of Physical Chemistry and G. G. Brown, et al., Unit Operations.